Fishery Data Series No. 02-04

Under-Ice Gillnet Harvest of Sheefish in Hotham Inlet in 2000-2001

James W. Savereide

April 2002

Alaska Department of Fish and Game Division of Sport Fish

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used in Division of Sport Fish Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications without definition.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
id est (that is)	i.e.,
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	log_2, etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
variance	Var

FISHERY DATA SERIES 02-04

UNDER-ICE GILLNET HARVEST OF SHEEFISH IN HOTHAM INLET IN 2000-2001

by

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April 2002

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Annual Report Summary Page

Title: Under-Ice Gillnet Harvest of Sheefish in Hotham Inlet in 2000-2001

Study Number: FIS00-20

Geographic Area: Region 8 (Northwest Arctic)

Information Type: Subsistence Fishery Harvest Monitoring

Issue(s) Addressed: The lack of information on the number of sheefish harvested in the winter gillnet fishery.

Study Cost: $69,600

Study Duration: September 15, 2000- May 15, 2001

Abstract: In northwestern Alaska sheefish *Stenodus leucichthys* are harvested in subsistence, sport, and commercial fisheries. Most of the total harvest, however, is taken for subsistence. Winter subsistence harvests have been the largest component of the subsistence fishery and are poorly documented. Investigators conducted a complete survey of the under-ice gillnet fishery by contracting fishermen to record their harvest over the entire fishing season. Fifteen fishermen participated in the fishery and survey. A sample of scales was collected to estimate the age composition, and a sample of fish as measured to estimate length composition of the harvest. The survey indicated 14,533 sheefish were harvested. The 574 sheefish sampled ranged from 8 to18 years of age and 580 to 960 mm in fork length. The largest proportion of sheefish in the harvest was age 13, and most were 775-799 mm long.

Key Words: Kotzebue Sound, Kobuk River, Kobuk sheefish stock, Hotham Inlet, Kobuk Lake, Selawik River, Selawik sheefish stock, sheefish *Stenodus leucichthys*, subsistence fishery, under-ice gillnet

Project Data: *Description* – Data from this study consist of biological samples (scales), biological data (length and age), and information on the harvest of sheefish (date, fishermen, gear type, size and length). *Format* – scale samples were stored on gum cards with corresponding scale impressions on acetate, and biological and survey information was stored in Microsoft Excel spreadsheets. *Custodian(s)* – Sampling and survey data are maintained by Alaska Department of Fish and Game, Division of Sport Fish, 1300 College Road, Fairbanks, Alaska 99701. *Availability* – Access to biological samples and data is available upon request to the custodians.

Citation: Savereide, J. W. 2001. Under-Ice Gillnet Harvest of Sheefish in Hotham Inlet in 2000-2001. Alaska Department of Fish and Game, Fishery Data Series No. 02-03, Anchorage.

ABSTRACT

Sheefish *Stenodus leucichthys* or inconnu are a vital component of subsistence fisheries in the vicinity of Kotzebue in northwestern Alaska. A winter gillnet fishery in Hotham Inlet comprises the largest proportion of Kotzebue's subsistence sheefish harvest, but the harvest has not been documented reliably. The Hotham Inlet sheefish population is thought to be two separate and distinct stocks, the Kobuk and Selawik. Concerns voiced by local subsistence users over the potential overharvest of sheefish from the less abundant Selawik stock in the winter gillnet fishery warrants collecting information that will aid managers in making informed management decisions. This study quantified the harvest of sheefish by local residents using gillnets under the ice on Hotham Inlet and estimated the length and age composition of harvested sheefish.

The total surveyed harvest of sheefish in the winter gillnet fishery was 14,533 fish. Sheefish examined for length varied from 580 to 960 mm FL. The length composition revealed that a large proportion of sheefish (16.0%) in the harvest measured between 775 and 799 mm FL. The ages of sheefish ranged from 8 to 18, and a large proportion (26.0%) were age-13.

The lack of biological information on the population and the subsistence harvest warrants a cautious approach to the management of this subsistence fishery. The current level of subsistence harvest coupled with information about the spawning abundance, however, suggest that the current management practice allowing for traditional use and sport harvest of sheefish is sustainable and will allow for a viable and productive sheefish population.

Key Words: Kotzebue Sound, Kobuk River, Kobuk sheefish stock, Hotham Inlet, Kobuk Lake, Selawik River, Selawik sheefish stock, sheefish *Stenodus leucichthys*, subsistence fishery, under-ice gillnet

INTRODUCTION

Sheefish *Stenodus leucichthys* populations are distributed throughout the holarctic from the White Sea in Russia, across Siberia and Alaska, to the Anderson River in northwestern Canada. Sheefish in Alaska are mainly found in large estuaries and associated river drainages. Large populations occur along the west coast of Alaska in the Kuskokwim, Yukon, Kobuk, and Selawik river drainages.

The estuarine anadromous life history (Alt 1987) of sheefish presumably evolved to capitalize on the growth benefits of an estuarine environment and the reproductive benefits of a freshwater environment. Sheefish migrate great distances to reach spawning grounds by late fall. These fish overwinter near the mouths of large river systems or in large freshwater lakes and inlets. Sheefish in the Yukon River travel up to 1600 km to spawning grounds and those in the Kobuk River travel approximately 450 to 670 km to spawn. Sheefish mainly occupy slow moving reaches of the river when not spawning. In contrast, spawning areas are shallow and swift upriver reaches with gravel substrate.

The spawning migration of mature sheefish in the Kobuk River is an extension of the seasonal feeding migration of the population. Soon after ice breakup sheefish in the Kobuk River move upstream and by late June are near the village of Kiana, approximately 100 km from the mouth of the Kobuk River (Figure 1). Non-spawners rarely migrate more than 180 km upstream. In contrast, spawners continue upstream and arrive near Ambler, 265 km from the mouth, around the middle of July at which time the migration slows and the population disperses. Pre-spawning sheefish arrive on spawning grounds between the village of Kobuk and the Reed River between August and early September. As frazzle ice begins to form, just days before freeze up, spawning occurs. When spawning is complete sheefish begin a downstream migration to overwintering areas near the mouth of the Kobuk River (Alt 1969 and 1987).

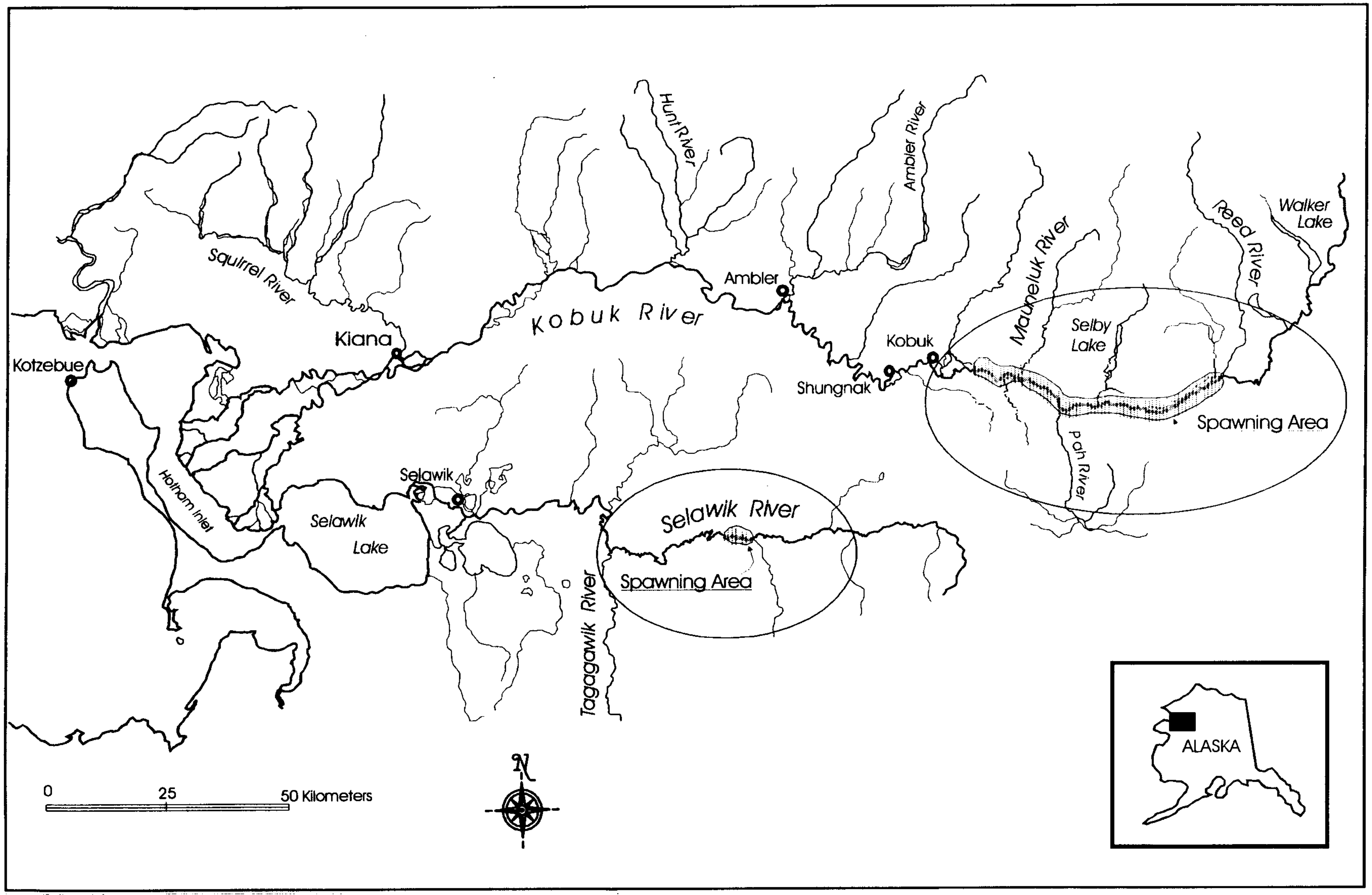


Figure 1.–Hotham Inlet and the surrounding area.

Sheefish are harvested in subsistence, sport, and commercial fisheries throughout northwestern Alaska. However, the harvest from sport and commercial fisheries is relatively insignificant when compared to the subsistence harvest. For example, in 1997 the subsistence harvest was 23,509 sheefish, the sport harvest 902, and commercial harvest was 0. Most of the sheefish harvest occurs in the Kotzebue District, which includes the Kobuk and Selawik rivers, Hotham Inlet, and Selawik Lake (Lean et al. 1992). There have also been reports from local fishermen of sheefish captured in the Noatak and Buckland rivers, which would be range extensions (Alt 1987). Northwest regional annual subsistence harvests are not fully documented (Appendix A1). The largest reported annual subsistence harvest was 31,293 in 1967–1968 (Brennen et al. 1999).

The subsistence fishery takes place in four phases that span the entire year. Sheefish are caught with gillnets during the summer on their upstream migration in the Kobuk and Selawik rivers; with beach seines during fall spawning; with gillnets set under the ice (Figure 2) during the winter in Hotham Inlet; and, when the winter gillnet fishery is ending in late April, with lures through holes drilled in the ice in Hotham Inlet and Selawik Lake. The winter under-ice gillnet harvest in Hotham Inlet comprises the largest proportion of the total documented harvest, although, Alt (1987) thinks most of the winter sheefish harvest is taken during the hook-and-line fishery.

The sport fishery occurs mainly in the upper Kobuk River, but sheefish are also harvested farther downstream in the Kobuk River and in the Selawik River drainage. Sheefish populations in the Kobuk and Selawik rivers contain the largest known sheefish in Alaska. Sheefish in these systems have been documented to weigh up to 26.5 kg (Alt 1987). Due to the large size of its sheefish and relatively easy access, the Kobuk River has become popular with sport anglers.

The Kobuk River sport harvest, in comparison to the subsistence harvest, has been small: estimated annual sport fish harvest from 1990 through 1998 averaged 370 fish (Appendix A2) and ranged from 135 fish in 1994 to 748 in 1995 (Mills 1991–1994, Howe et al. 1995, 1996, 2001a, b). Estimated annual sport fish catches (including fish that were released) from 1990 to 1998 averaged 1,239 fish (Mills 1991–1994; Howe et al. 1995, 1996, 2001a, b). Furthermore, over this time period sheefish from the Kobuk River accounted for, on average, 23% of the statewide sheefish sport harvest and catch.

User conflicts have been noted between upper Kobuk River residents and sport anglers (Georgette and Loon 1990). The current sport fishing regulations for the Kobuk River were adopted in 1987 to minimize the conflicts with subsistence fishers by holding annual sport fish harvests below pre-1987 levels. The sport fish daily bag and possession limit is 2 sheefish per day, 2 in possession, and no size limit upstream from the mouth of the Mauneluk River; and 10 per day, 10 in possession and no size limit for the remainder of the river.

The commercial harvest is also relatively small compared to the subsistence fishery (Appendix A3). Annual commercial harvest has averaged 1,334 sheefish from 1967 to 1994. However, Brennen et al. (1999) suggested that unreported commercial harvests are relatively common, so reported harvest totals should be viewed as minimum estimates. Currently the annual commercial harvest quota for Kotzebue District is 25,000 pounds.

Abundance indices of sheefish spawners in the Kobuk River have been made sporadically. Aerial survey counts obtained by ADF&G Commercial Fisheries Division between 1966 and 1971 averaged 3,706 and ranged from 1,025 to 8,166 (Alt 1987). Surveys flown in 1979, 1980, 1984, 1991 and 1992 averaged 5,617 fish and ranged from 1,722 to 17,335 (Lean et al. 1996).

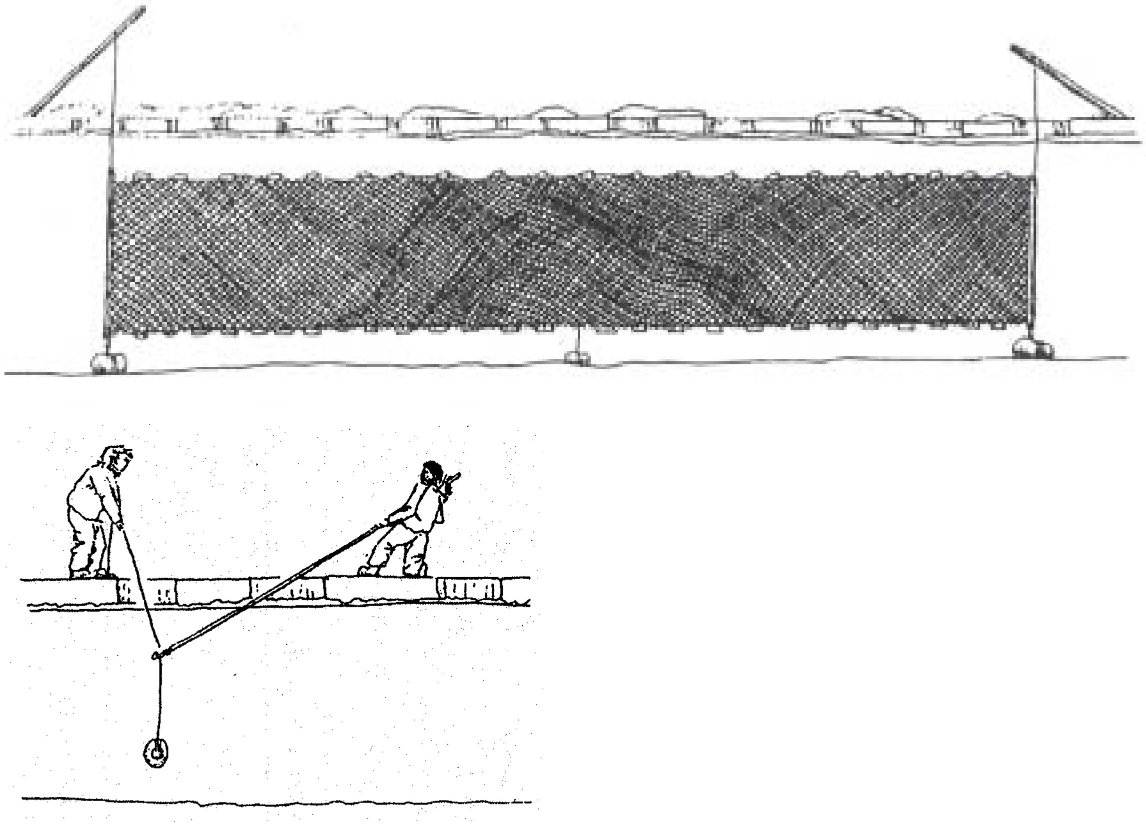


Figure 2.–Schematic of setting a gillnet under the ice. Showing a line being threaded through a series of holes with a long hooked pole.

Total abundance of sheefish spawners in 1996 was estimated to be 43,036 in the Kobuk River (Taube 1997), and 5,157 in the Selawik River (Underwood et al. 1998). Genetic samples collected in 1993 and 1994 indicate that sheefish from these rivers comprise two separate and distinct stocks (Miller et al. 1998). These results are further supported by two tagging studies: a total of 1,314 sheefish were tagged in the Selawik River during 1993-96 (Underwood et al. 1998) and 1,995 fish were tagged in the Kobuk River during 1994-95 (Taube 1996). Sheefish tagged in one river were not recovered in the other river, suggesting that sheefish return to the river in which they had previously spawned in (Miller et al. 1998). While genetic similarities between the two stocks suggest the rivers were colonized from a common source, any gene flow between the two stocks is not great enough to overcome the forces that maintain genetic differences, such as fidelity to natal spawning grounds (Miller et al. 1998).

Based on tag returns from the winter gillnet and hook-and-line fisheries, both Kobuk and Selawik sheefish stocks use Hotham Inlet and Selawik Lake as overwintering areas (Taube and Wuttig 1998). As suggested by the 1996 abundance estimates for these spawning stocks, Kobuk sheefish also appear to be more abundant than Selawik sheefish in these overwintering areas. Eight tags were recovered from the 1995-96 Selawik Lake hook-and-line fishery, and three of those were from sheefish tagged on Kobuk River spawning grounds. Furthermore, 69% of the tags returned from the 1995-96 Hotham Inlet winter subsistence fishery (gillnet and hook-and-line) and 80% returned from the 1996-97 Hotham Inlet fishery were from sheefish tagged on the Kobuk River spawning grounds. These results also show that the winter subsistence fishery is a mixed stock fishery.

Sheefish populations of the Kobuk and Selawik rivers are subject to subsistence, commercial, and sport fisheries. The subsistence fishery is the largest of these, but is not well documented. Lack of subsistence harvest information places unknown risk on an extremely important subsistence fishery. This study estimated the number, as well as the age and length composition, of sheefish harvested by local residents using under-ice gillnets on Hotham Inlet in the winter of 2000-2001.

OBJECTIVES

The objectives of this study during 2000-2001 were:

1) to document the total harvest of sheefish from the under-ice gillnet fishery in Hotham Inlet; and,
2) to estimate the length and age composition of the harvest.

METHODS

HARVEST SURVEY

The under-ice gillnet harvest of sheefish was determined through a survey of fishery participants. Initial contacts were made with past fishery participants by phone before the fishery started. At that time a follow-up personal meeting was scheduled to explain the project design and sampling procedures. Fishermen were asked about other possible fishery participants, which were noted and then contacted. The importance of keeping accurate and timely harvest records was explained to every participant. Fishery participants were paid $300.00 to record their catch for the season (catch data were recorded each time nets were checked). Data recorded by each participant included: 1) net length, 2) mesh size, 3) date of net check, and 4) number of sheefish captured. Since all fishery participants cooperated in the survey, an estimate of the undocumented portion of the harvest was not required.

A locally hired fisheries technician visited with each participant, approximately once every two weeks, to ensure harvest records were being accurately kept. All visits took place at the fishermen's residence or fish camp. Fishermen checked their gillnets as weather and time allowed. During each visit the technician collected harvest records, obtained scales, measured fish, and compiled the data.

LENGTH AND AGE COMPOSITION OF THE HARVEST

The technician measured thirty sheefish from the harvest of each participant on the day of each visit. The sample consisted of all sheefish harvested between visits. If there were fewer than thirty sheefish, the technician sampled all the fish present. If there were more than thirty sheefish, the technician measured the first thirty fish encountered. Three scales were collected from the left side of each sheefish from an area posterior to the dorsal fin approximately midway between the lateral line and the base of the dorsal fin (Alt 1969). Scales from each sheefish were placed into an envelope, and the date, species, fork length, sample number, and name of participant were recorded on the outside of the envelope.

Scales were later mounted on gummed cards and pressed on acetate sheets in a heated hydraulic press (30 seconds at 7,000 kg/cm^2, at 100^o C) to make scale impressions. The scale and card number assigned to each sheefish corresponded with those on the envelope so the relationship between age and length could be determined. Sheefish ages were determined from scale impressions using a microfiche reader. Annulus determination was made using the criteria described by Alt (1969). Two different people aged each scale: the technician in Kotzebue and a previously trained technician in Fairbanks. A total of three readings were performed: one by the Kotzebue technician and two by the Fairbanks technician.

Estimates of the proportion in each age or length class, $\hat{p}_c$, and its variance, $\hat{V}(\hat{p}_c)$, were estimated as follows:

$$\hat{p}_c = \frac{h_c}{h} \quad \text{, and} \tag{1}$$

$$\hat{V}(\hat{p}_c) = \left(1 - \frac{h}{H}\right)\frac{\hat{p}_c(1-\hat{p}_c)}{h-1} \tag{2}$$

where:

h = total number of sheefish sampled from the harvest

h_c = number of sheefish sampled in age or length class c;

H = total surveyed harvest of sheefish

Estimated number of sheefish harvested by age (8 through 18) and length (575 to 975 mm FL in 25 mm increments) categories were estimated as:

$$\hat{H} = H\,\hat{p}_c\,, \tag{3}$$

and the variance was calculated as (Goodman 1960):

$$\hat{V}\left(\hat{H}_c\right) = H^2\ \hat{V}\left(\hat{p}_c\right) \tag{4}$$

A k-sample Anderson-Darling (A-D) test was used to look for significant differences (p=0.05) between cumulative length distributions of the sheefish sampled from gillnets with different mesh sizes (Scholz and Stephens 1987). The A-D test accommodated unequal sample sizes and tested all sampled distributions simultaneously. The null hypothesis was that cumulative length distributions of the samples were not different. To determine whether different mesh sizes yielded similar size distributions, a series of 15 two-sample A-D tests was performed. In order to maintain Type 1 error of alpha = 0.05, the Bonferroni method (Neter and Wasserman 1974) indicated that the null hypothesis should be rejected when $p<0.0033$ for a two-sample test.

RESULTS

HARVEST SURVEY

A total of 15 fishermen participated in the under-ice gillnet fishery in Hotham Inlet during the winter of 2000-2001. Most fishing occurred in the northern and eastern portions of Hotham Inlet (Figure 3).

The total harvest taken during the 2000-2001 winter gillnet fishery was 14,533 sheefish. The 15 fishermen used 19 nets with mesh sizes ranging from 5 ⅞ to 7 inches (150 to 178 mm), and lengths ranging from 7 to 50 fathoms (12.8 to 91.5 m). Fishing began as soon as the ice was thick enough to travel on and fish safely. The first sheefish were harvested in late October, and fishing continued until late April. Fifty percent of the total gillnet harvest occurred during the first nine weeks of the survey (Figure 4). The largest harvests occurred during the first and third weeks of November, and the third week of January.

LENGTH AND AGE COMPOSITION OF THE HARVEST

A total of 574 sheefish was sampled to obtain fork length measurements. Fork lengths of sheefish examined ranged from 580 mm to 960 mm FL. Mean fork length was 774 mm, with a large proportion of the sample within the 775 mm FL category (775 – 799 mm FL; $p= 0.16$; $SE = 0.015$; Figure 5). Seventy-five percent of sheefish examined were less than 825 mm FL (Figure 5). Assuming the 574 sheefish sampled were a good representation of the total harvest, most (82%) of the sheefish harvested ranged from 675-825 mm (11,992 sheefish; Table 1). Of the 574 sheefish sampled for age determination, 519 were used to estimate the age composition. Age of these sheefish ranged from 8 to 18 years. A large proportion of sheefish in the harvest was age-13 ($p = 0.26$; $SE = 0.019$; Figure 5). Most (90%) of the sheefish harvested ranged in age from 11 to 15 years (13,025 sheefish; Table 2).

The k-sample A-D test comparing length distributions from 6 different mesh sizes (5⅞ inches to 7 inches) rejected the null hypothesis ($T_{akN} = 30.2$, $p < 0.0001$): the 2-sample A-D tests comparing samples from one mesh size to another failed to reject the null hypothesis in all cases except one. The results indicate the length distribution of sheefish from the 5⅞ inch gillnet was

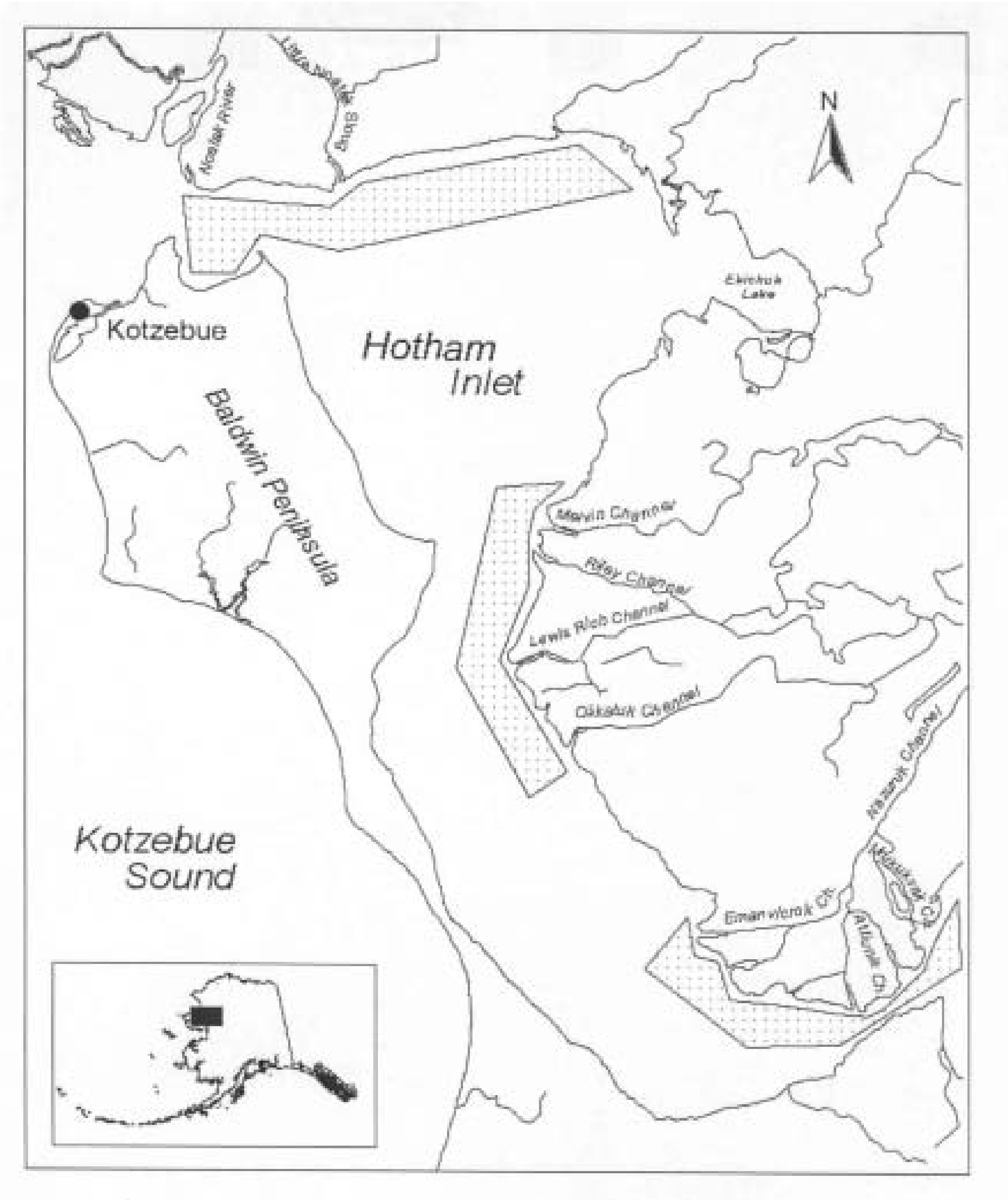


Figure 3.-Approximate fishing locations on Hotham Inlet.

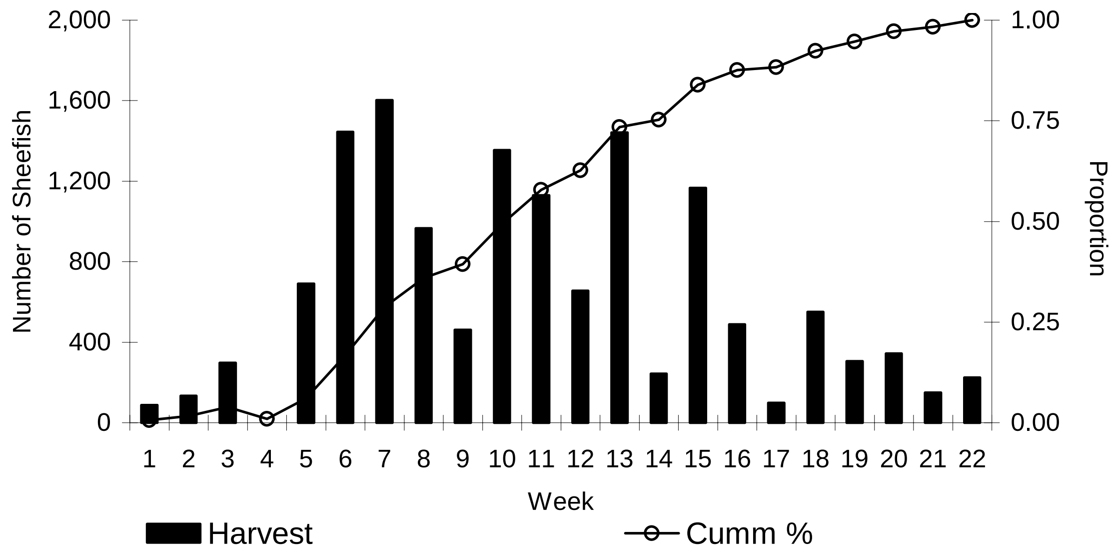
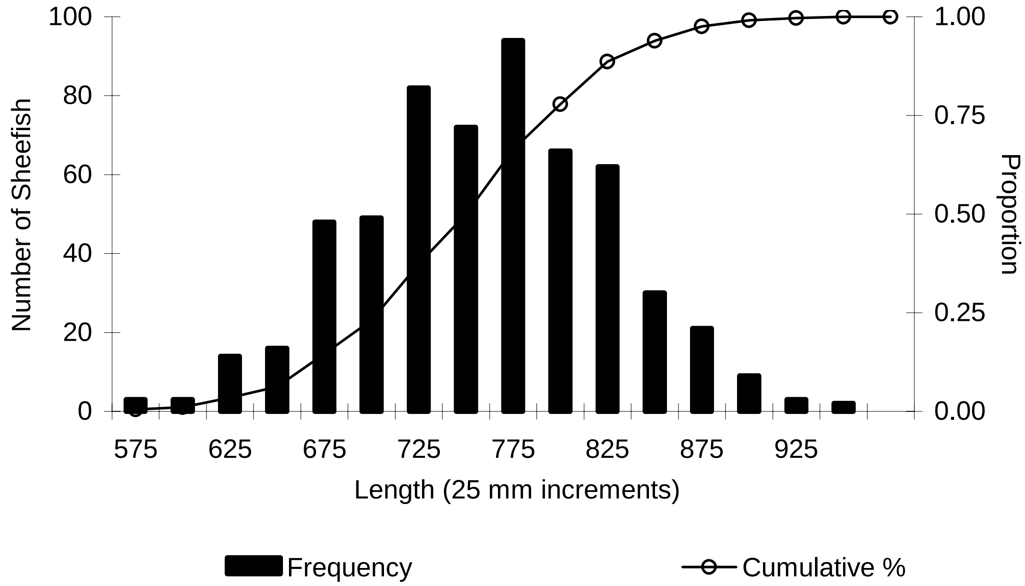


Figure 4.–Number of sheefish and cumulative proportion harvested by week in the under-ice gillnet fishery on Hotham Inlet.



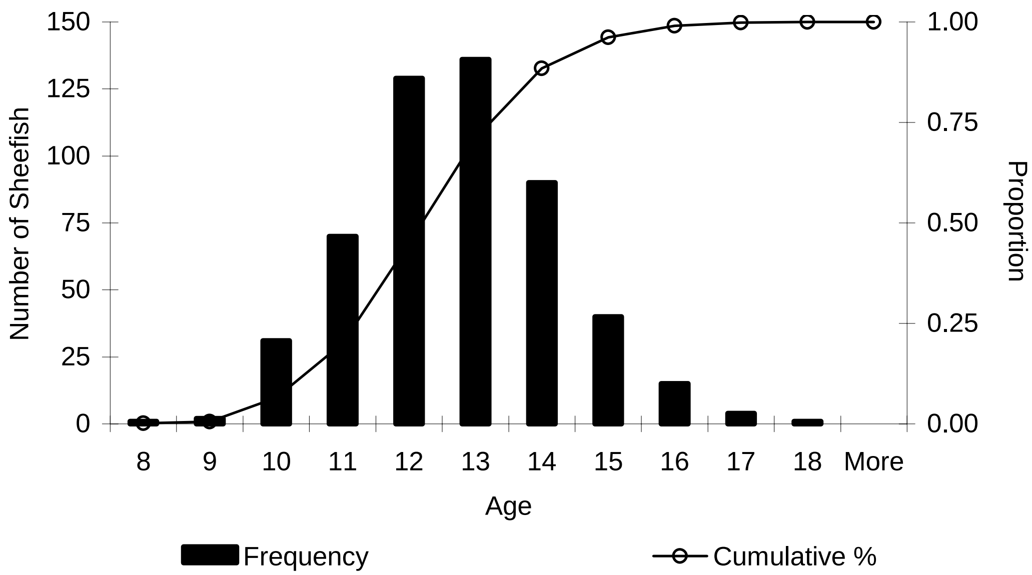


Figure 5.–Number of sheefish and cumulative proportion of sheefish harvested by length and age in the under-ice gillnet fishery on Hotham Inlet.

Table 1.–Estimated number of sheefish harvested in each length category.

Length Category	Number in Harvest	SE
575	76	43
600	76	43
625	355	92
650	406	98
675	1,217	165
700	1,242	166
725	2,079	209
750	1,825	197
775	2,383	221
800	1,673	190
825	1,572	185
850	761	133
875	532	112
900	228	74
925	76	43
950	52	35

Table 2.–Estimated number of sheefish harvested in each age category.

Age Category	Number in Harvest	SE
8	27	28
9	55	39
10	868	149
11	1,962	214
12	3,616	271
13	3,813	276
14	2,523	238
15	1,121	167
16	420	105
17	111	55
18	27	28

the only gillnet sample significantly different from samples in gillnets of other mesh sizes ($p < 0.0001$; Figure 6).

DISCUSSION

Knowledge of the dynamics of the harvested population is important when managing fisheries. Results of genetic studies mark-recapture studies indicate at least two separate stocks of sheefish (Kobuk and Selawik rivers) overwinter in Hotham Inlet and Selawik Lake (Miller et al. 1998). If harvests are great enough, the potential exists to overharvest the less abundant Selawik stock (Miller et al. 1998; Taube and Wuttig 1998), and managers would need to set stock specific harvest guidelines. Establishment of stock specific guidelines requires information on movement and distribution by stock, abundance estimates of the stocks being exploited (spawners and non-spawners), total number of sheefish harvested in all fisheries (subsistence, commercial, and sport), and the proportion of fish harvested from each stock.

While genetic and mark-recapture studies have provided useful information, many information gaps remain to be filled. Estimates of the spring hook-and-line subsistence fishery are not available, stock abundance estimates include only spawning fish, and information on either the amount of overlap between stocks in overwintering areas or the proportion of each sheefish stock harvested has not been collected. Information that has been obtained on abundance, harvest, stock structure, and age and length composition for the winter subsistence fishery does provide some insight into the sustainability of this resource.

HARVEST SURVEY

The total 2000-2001 winter gillnet harvest of sheefish (14,533) is similar to harvest estimates for 1995-1996 (15,161) and 1996-1997 (13,704). Eighteen of 22 participants in the subsistence gillnet fishery were interviewed in 1996-1997 (Taube and Wuttig 1998). We were careful to ensure all 22 of these fishermen were contacted and asked to participate in our project. While a few fishermen that participated in this fishery in 1996-1997 were unwilling to participate in our survey, none of them fished during the 2000-2001 season, although some obtained sheefish from participating fishermen. Our continued contact with the fishermen throughout the fishing season ensured a reliable count, actively involved each subsistence fisher, and allowed us to estimate the age and length composition of the harvest from samples obtained throughout the fishery.

The largest harvests were taken during the first and third weeks of November, and the third week of January. This occurred because a number of fishers started fishing at the beginning of the season, and they stopped fishing when they harvested the number of sheefish required for their subsistence use. Also, the hook-and-line fishery begins in late February to early March and a number of gillnet fishermen switched to this method of fishing.

LENGTH AND AGE COMPOSITION OF THE HARVEST

The age and length composition of the harvest is indicative of the gillnet mesh sizes used by subsistence fishers. The age and length composition appeared to be normally distributed around a mean age of 12 and a mean fork length of the 750 mm. The largest proportion of sheefish sampled for a mark-recapture experiment on the Kobuk River in 1997 were age-13 and 875-900 mm in fork length (Taube and Wuttig 1998). The difference in age and length compositions may be due to seasonal differences in the population from which samples were taken. The mark-recapture experiment took place during the fall when most sheefish sampled were in the

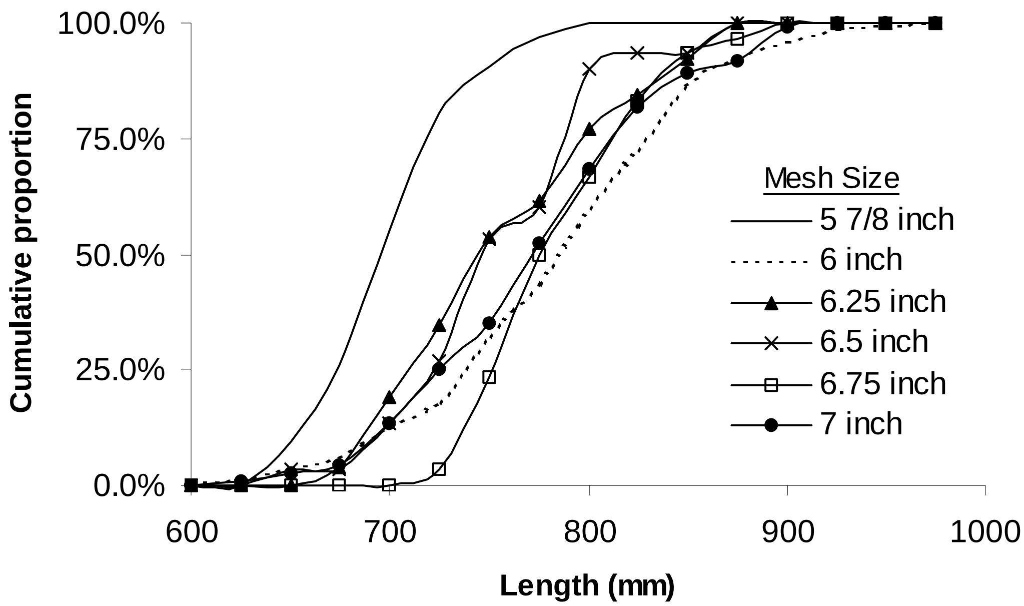


Figure 6.-Cumulative length distributions of sheefish harvested from gillnets with varying mesh sizes.

spawning population. Spawning sheefish tend to be larger than non-spawners since they are older.

The fisher using a 5⅞ inch gillnet during the first few of weeks of the season caught a significantly different ($p<0.0001$) length distribution of fish compared to those caught in other gillnets with larger mesh sizes. While it is not surprising that larger mesh sizes to tend to catch larger fish, this may also have been accentuated by differences in a temporal and spatial distribution of sheefish early in the season.

The limited amount of information available warrants a cautious approach in making management decisions for the Hotham Inlet fishery. Genetic, abundance, length-at-age, and harvest information should be collected regularly to ensure the Kobuk and Selawik stocks remain viable and productive (Miller et al. 1998). A genetic mixed stock analysis of winter subsistence fishery samples would provide important information concerning the temporal and spatial distribution of these stocks and their contribution to the subsistence harvest. Additionally, if several years of catch-at-age data were available, models could be developed using auxiliary information from other studies to describe the underlying dynamics of the population. Nevertheless, after examining 22 years of sheefish observations, speaking with local fishermen, and describing range extensions for sheefish, Alt (1987) considered this fishery to be healthy and sustainable. Our more recent observations on the size and age structure of the winter harvest suggests that these stocks have continued to remain productive and do not appear to be heavily exploited.

CONSULTATIONS AND CAPACITY DEVELOPMENT

I trained a local resident as a fisheries technician to collect biological information and determine the age of fish by reading scale impressions. This technician also greatly aided in consultations with subsistence users. These consultations ensured subsistence fishers understood the project and made them more willing to participate in the survey. Fifteen local residents and their families participated in the study. Preliminary and final results of this project were provided to the participants and other local agencies (ADF&G, USFWS, and NPS). By providing important information on the winter subsistence gillnet harvest, this study allowed management agencies to make better informed decisions that will help ensure subsistence harvest opportunities are maintained for this important resource.

CONCLUSIONS

The harvest survey and sampling of the under-ice gillnet fishery in Hotham Inlet provided:

1. a total estimate of the number of sheefish harvested;
2. an accurate estimate of the length-and-age composition of the harvest;
3. a method of sampling this fishery that could be used to estimate the relative contribution of Kobuk and Selawik sheefish to the harvest once more genetic information is known; and,
4. support for current management practices.

RECOMMENDATIONS

I recommend that the Federal Office of Subsistence Management support:

1. continued efforts to survey and sample the harvest, including use of genetic mixed stock analysis;
2. studies to estimate the total harvest of sheefish from these stocks; and,
3. studies to develop age and length structured assessment models.

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APPENDIX A

Appendix A1.-Reported subsistence sheefish harvests, Kotzebue District, 1966-2000[a].

Year	Number of Fishermen Interviewed	Reported Harvest	Average Catch Per Fisherman
1966-67	135	22,400	166
1967-68	146	31,293	214
1968-69	144	11,872	82
1970	168	13,928	83
1971	155	13,583	88
1972	79	3,832	49
1973	65	4,883	75
1974	58	1,062	18
1975	69	1,637	24
1976	57	966	17
1977	95	1,810	19
1978	95	1,810	19
1979	75	3,985	53
1980	74	3,117	42
1981	62	6,651	107
5/82-4/83[b]	130	4,704	36
5/83-4/84[b]	27	764	28
5/84-9/84	30	2,803	93
1985[c]	2	60	30
1986[b,c]	72	721	10
1987[c]	46	276	6
1988[c,d]	-	-	-
1989[d]	-	-	-
1990[d]	-	-	-
1991	40	2,180	55
1992	43	2,821	66
1993[d]	-	-	-
1994[e]	171	3,181	84
1995[e]	314	9,465	24.6
1996[e]	389	6,465	18
1997[e]	338	9,805	24.6
1998[e]	435	5,350	13.6
1999[e]	191	8,256	18.6
2000[e]	237	7,446	16.6

[a] Due to limited survey effort during many years, total catch and effort are minimum figures, not comparable among years.

[b] Summer catches only; winter catches were not documented.

[c] Data collected during fall subsistence salmon surveys and may include summer and winter catches.

[d] Subsistence sheefish catches not documented.

[e] Reported harvests are from Kobuk River villages only.

Appendix A2.–Sheefish sport harvests and catches 1977-1998 (Mills 1979-80, 1981a, b, 1982-1994; Howe et al. 1995, 1996, 2001 a, b, c, d; Walker et al. *In prep*).

Year	Kobuk River Harvest	Kobuk River Catch [a]	NW Alaska Harvest	NW Alaska Catch [a]	Alaska Harvest	Alaska Catch [a]
1977	625	-	656	-	1,247	-
1978	307	-	506	-	1,291	-
1979	682	-	709	-	1,542	-
1980	1,248	-	1,713	-	2,411	-
1981	1,015	-	1,263	-	2,239	-
1982	1,886	-	2,222	-	3,281	-
1983	1,448	-	2,079	-	3,323	-
1984	740	-	3,050	-	3,947	-
1985	1,330[b]	-	1,645	-	2,520	-
1986	1,590[b]	-	3,363	-	3,721	-
1987	865	-	1,836	-	2,597	-
1988	964[b]	-	946	-	3,221	-
1989	131	-	629	-	2,306	-
1990	151	336	151	403	750	3,360
1991	579	1,568	603	1,616	2,256	3,989
1992	627	2,034	1,904	3,678	2,933	6,587
1993	395	1,074	1,029	2,273	1,619	6,666
1994	135	386	564	958	1,511	2,981
1995	748	2,669	1,142	3,270	2,200	6,623
1996	245	1,146	362	1,456	748	3,442
1997	304	1,317	902	2,333	1,761	5,452
1998	145	617	414	924	815	3,303
1999	621	5,070	635	5,134	1,157	7,507
2000	361	1,768	1,195	3,352	2,037	5,917

[a] Sport fish catch was not reported until 1990.

[b] Sheefish harvest is for streams in NW Alaska.

Appendix A3.–Kotzebue District winter commercial sheefish harvest statistics, 1971–2000 [a].

Year[b]	Number of Fishermen	Number of Fish	Pounds Total	Pounds Average	Price/pound	Estimated Value
1971	4	73	720	9.9	$0.13	$95
1972	5	456	4,071	8.9	$0.16	$651
1973	11	2,322	15,604	6.7	$0.20	$3,121
1974	6	1,080 [d]	6,265	5.8	$0.30	$1,880
1975	[c]	2,543 [d]	24,161	9.5	$0.30	$7,248
1976	14	2,633	19,484	7.4	$0.30	$5,845
1977	2	566	5,004	8.8	$0.30	$1,501
1978	11	2,879	26,200	9.1	$0.40	$10,480
1979 [e]						
1980	4	1,175	8,225	7.0	$0.50	$4,113
1981	1	278	1,836	6.6	$0.75	$1,377
1982	11	2,629[f]	17,376	6.6	$0.75	$13,032
1983	8	1,424	13,395	9.4	$0.50	$6,698
1984	5	927 [d]	10,403	11.2	$0.55	$5,722
1985	4	342 [d]	3,902	11.4	$0.51	$1,990
1986	2	26	312	12.0	$0.75	$234
1987	3	670	5,414	8.1	$0.49	$2,653
1988	3	943	7,373	7.8	$0.45	$3,318
1989	8	2,335	16,749	7.2	$0.51	$8,542
1990 [c]	6	687	5,617	8.2		
1991	5	852	8,224	9.7	$0.50	$4,112
1992	3	289	2,850	9.9	$0.65	$1,853
1993	1	210 [d]	1,700	8.1	$0.50	$850
1994 [e]						
1995	1	226	2,240	9.9	$0.50	$1,120
1996	2	308	3,002	9.7	$0.44	$1,321
1997 [e]						
1998 [e]						
1999 [e]						
2000 [e]						

[a] Data is not exact, some total catch poundage was determined from average weight and catch data. Similarly, various price/pound figures were determined from price/fish and average weight data.

[b] Season was from Oct. 1 through Sept. 30. Year indicated is year commercial season ended. For example, the year 1980 represents Oct. 1, 1979 to Sept. 30, 1980.

[c] Data unavailable or incomplete.

[d] Number of fish not always reported. Estimates based on average weight from sales that documented the number of fish.

[e] No reported commercial catches.

[f] Estimate based on historical average weight.